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OF THE
SCIENCE OF ELECTROPLATING

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MONTHLY REVIEW

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VOL. XIX APRIL, 1932 No. 4

Practical Methods *Plus* Technical Maintenance *Equal* Standardization

By C. E. Clindinin, General Spring & Bumper Corp.

Read at Chicago Branch Annual Meeting, February 27, 1932

Observations and suggestions are the thought in preparing this paper. It is not the purpose to criticise, in any way, other than constructively. If, by making a few observations and asking a few questions, your thoughts may be stimulated constructively it will amply repay any effort on the part of the writer.

If every electroplater in the United States were present in this room today and we could pass out slips of paper upon which to answer these two questions:

1. Why are you a plater?
2. Why is the electroplating industry?

The respective answers invariably would be:

1. To make money.
2. To enable those engaged in the industry to make money.

Personally, I believe both answers would be wrong in the true sense of the word. The correct answer to both questions is: TO RENDER SERVICE.

To serve the users of plated articles better, and to help establish a standard of quality is the aim of our Research Committee, the American Society for Testing Materials, the Bureau of Standards and our own American Electro-Platers Society.

The American Steel Treaters Society publishes a handbook of standards and accepted shop practices every year, adding to or correcting each year as experience develops new things or improves the old. In like manner, the Society of Automotive

Engineers issues a yearly handbook giving standards established by research covering almost every operation and material used in the construction of automobiles and airplanes.

Is there any reason why there should not be an A.E.S. handbook containing standard solution formulæ, methods of testing and control and data on standards of electrodeposition to obtain certain desired resistances to corrosion and abrasion.

If one takes his automobile to a job shop to have the bumper, radiator shell, lamps and other hardware replated, how many are there in the industry who can tell what they will give as a standard? Has the owner of the car a right to ask that question? Is there any A. E. S. standard that may be asked for and guaranteed? Will any instructions be given as to the care of the plated parts to obtain maximum service?

The American Electro-Platers Society is trying to function in cooperation with its Research Committee, the Bureau of Standards and the American Society for Testing Materials. There is no doubt of the effort or the will to do this, but is the most obtained from these efforts and purposes?

It is not the writer's intention to criticise the effort or the will in any way, but to ask a few questions in the hope that your thoughts may be so directed as to obtain more from the effort. Does each one of us, when we discover something of interest to the A.E.S. as a society of men striving to improve our education in the art of electrodeposition of metals, give the facts of our discovery or method to the society or the Research Committee or do we selfishly keep this information to ourselves? Should we allow the Research Committee to spend a lot of time and money on a problem without first giving them the advantage of what we already know on the subject? We all have certain methods of handling certain work and many times have succeeded in overcoming a difficulty in a way that would be of great interest to the society and the Research Committee. You might think it unimportant but, on the contrary, it might be very valuable information.

We are a society composed mostly of practical men; just a few technical men here and there. Are these technical men looked upon too much as theoretical rather than technical? Practical men do a thing and get a result but sometimes they have difficulty in maintaining the same standard. To the extent of our technical

training are we able to maintain that standard? The practical man needs the technical man and the technical man needs the practical man. As time goes on we find the practical man becoming more technical and the technical man more practical. Which one is making the better progress?

If each and every member of the A.E.S. would give his theories and ideas for the improvements in the art in which we are engaged to the Research Committee and the Bureau of Standards, how much progress do you suppose could be made in the next five years? Just stop and consider the total payroll of the plating industry and the potential man-hours per month. If the Research Committee could have the benefit of our findings, its value to our Society would be increased many times. It is for you and for me to decide whether this committee should receive our assistance or spend many valuable hours in repetition of our work, hours that could be devoted to problems that have not already been worked out. Each branch could have a committee to check over these suggestions, thus avoiding useless repetition. Any man has a right to his opinion and should not change it until sufficient proof has been presented to convince him that his conclusions are wrong. It is equally possible that you may be right and convince the other fellow that he is in error, thus doing your fellow plater a favor. Much is to be gained by discussion if carried on in the proper spirit. Do not forget that the other fellow has received his share of that commodity called "intelligence."

We have books published on electrodeposition and many articles in trade journals. Some booklets and plating articles should have been destroyed before they ever reached the printer. Many plating articles are merely notions or quick conclusions drawn from a too narrow viewpoint. We are all victims of this malady to a more or less degree and its best cure is association in like manner with open-minded and informed men of the plating industry, who have opinions of their own. Only a few years ago the standards of quality and methods employed were almost as diversified as there were plating plants. The society has brought together many of the platers of these plants, thus enabling each one to be benefited by association with the others.

But what is your answer to this question? "With the proper co-ordination could a list of standard solutions, standard methods

and shop practices be boiled down, sorted and published in an A. E. S. handbook that would be our own?" Such a book would help us individually and assist the society towards establishing A. E. S. standards.

Science is defined as organized facts.

A profession is employment, not mechanical but requiring some degree of learning.

You are all professional men, but are you scientific? In other words, are all your facts organized?

You know life is not all a game of "get." One must "give" if he would "get."

It is part of your duties, obligations and responsibilities as members of the American Electro-Platers Society to "give" to the Research Committee your ideas and theories and the facts you have organized and established and you will "get" a big dividend on your investment.

I am looking forward to the day not so far distant when every job shop and every manufacturer who has a plating department will hang out a sign and feature in their advertising:

"A. E. S. Standards Employed and Guaranteed"

Do you believe it is possible?

ALUMILITE PROCESS

Read before Anderson Branch

By Ralph E. Pettit, Aluminum Colors, Inc.

Through the Alumilite process there is offered to industry a reliable commercial method for the formation of an oxide coating on aluminum or its alloys.

Aluminum, which has a very marked resistance to surface attack, owes that resistance, in part at least, to a very thin oxide film which forms rapidly on the freshly exposed surface. The oxide film, presumably aluminum oxide Al_2O_3, is extremely resistant to natural corrosive influence and to a large number of industrial corrosive influences.

When electrical current is passed through a chemical bath of suitable composition, in which aluminum is suspended as the anode (positive electrode), the electrochemical and chemical reaction occurring between the aluminum surface and the bath components, causes the formation of the surface oxide film.

In preparing the work for treatment in the Alumilite bath, it is advisable to first buff to remove imperfections which might

detract from surface appearance. The work is then cleaned in a hot alkaline cleaner, which is followed with a water rinse.

The Alumilite process is carried out in a lead-lined tank, fitted with cooling coils and air agitation. During processing the temperature of the electrolyte is maintained between 72°F and 80°F, and the work subjected to a current density of approximately 15 amperes per sq. ft. at 12 volts.

Treatment time varies from 15 min. to 45 min., depending upon the time of service the article is to receive.

In the Alumilite bath the side of the lead tank serves as the cathode, and the extremely high throwing power of the Alumilite solution makes the use of special anodes unnecessary.

After the proper Alumiliting treatment, if the article is to be colored, it is water-rinsed and then placed in a color vat, until the proper depth of color is obtained in the film. This generally requires from 3 to 10 min.

The temperature of the coloring solution is held in the neighborhood of 180° F. After coloring, the work is water-rinsed and dried.

For articles that are to be in the natural-colored Alumilite finish, the Alumilite treatment is followed by a cold water and hot water rinse.

In addition to the remarkable resistance to corrosion offered by this film, it has several other very valuable properties. The electrical resistance of the Alumilite film is quite high. Laboratory tests show that potential breakdown of the film is in the neighborhood of 500 volts.

The extreme hardness of the film prevents scoring and burring of the soft aluminum surface when subjected to abrasive wear.

As mentioned above, this absorptive value of the film makes it possible to color articles by means of certain organic and inorganic coloring compounds.

By proper control of the operating conditions, such as bath temperature and bath composition, it is possible to produce a film on aluminum which can be successfully fabricated. Such articles as bottle caps and molding can be stamped from the Alumilite coated and colored sheet, without injury to the coating.

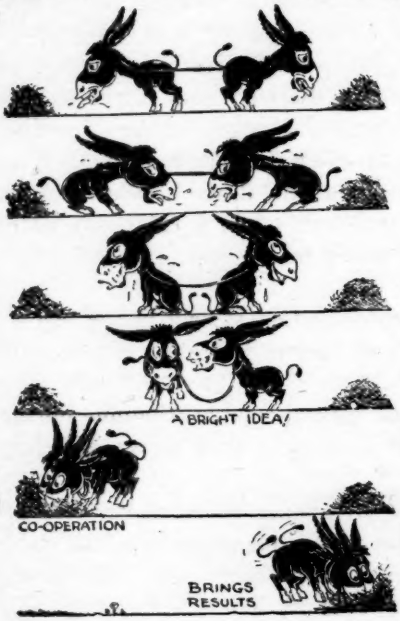
There are a number of Alumilite plants in operation throughout the country, processing a wide variety of aluminum articles.

American Electro-Platers Society

PHILADELPHIA CONVENTION

Benjamin Franklin Hotel

June 20th to 23rd, inclusive, 1932



"A Get-Together Fable"

but, nevertheless, a wisecrack in the moral.

Many a job can be accomplished by getting your heads together and by pulling together, and that is the kind of spirit that is shown by those who attend our Annual Convention each year.

The Society at its Montreal convention instructed the Supreme Secretary to send out a letter of invitation to all members and manufacturers inviting them to attend our convention; this has never been fully lived up to, not because the secretary did not live up to his job, but because a majority of the members themselves did not send in the names of their employers and we therefore could not send them an invitation.

Members should advertise themselves and their abilities and this can be accomplished by letting us send your employer a letter each year showing him the progress we are making, both for our members and for him.

All manufacturers appreciate and like to know their employees are trying to be the best in their line of work, but he

does not get to know this from the man himself, but has to get this information from a source outside, and that is where the invitation letter fits in; we cannot send your employer a letter unless we know his address, therefore this committee is trying to do all in its power to see that the Society has a manufacturers list, now won't YOU do your share and send your address and the address of your firm in at once to Geo. Gehling, 5001 Tulip St., Philadelphia, Pa.

The Philadelphia committee wants to see the conventions of the Society improve each year, therefore it is necessary for this committee to enlist your aid, and by pulling together we can have a grand convention and one which you will be proud to refer to in the future, knowing you did your share toward making it a success.

PITTING IN NICKEL SOLUTIONS

By W. M. Phillips, General Motors Corp.

Read at Chicago Branch Annual Meeting, February 27, 1932

Pitting is caused by dirt. One of the accepted definitions of dirt is matter misplaced and this will do as well as anything for the kind of dirt we want to talk about. There are other contributing causes but more about them later. Dirt is the villain responsible for pitting. It may be at the bottom of the pit but not always.

Dirt may be of any one or more of a variety of kinds:

1. It may be the abrasive in the buffing or polishing compound, which has not been entirely removed.
2. It may be the particles of cleaning compound dried on or otherwise adhering to the piece of work.
3. Dust particles picked up on the surface of the rinse tank or from the air during transfer.
4. Material which was suspended in the solutions used in processes, whether they be cleaning solutions, water or plating solutions.
5. Dirt from any cause which I have previously failed to mention.

Now after having enumerated all these ways that dirt can get on the piece I will proceed to elucidate how it functions. If other conditions are favorable to pitting, high rejections, swearing and cussing are prevalent, you can depend on the fact that dirt forms a focal point for the pit. Hydrogen is evolved selectively at this point, which makes the so-called hydrogen pit. Other things may

contribute, such as copper and ferrous iron. If so, they are bound also to have a focal point for their effect. The copper pit is easy to recognize. It has a black bottom or center. Ferrous iron produces a pit that is hard to tell from hydrogen. These pits both have bright centers.

Normal deposition may be resumed after a pit is formed. If so, such pits are hard to recognize until after the piece is buffed. This resumption of plating is generally caused by the removal of dirt at this point.

Anode particles or other conductive dirt often produce pits by first causing projections which are pulled out in buffing.

A little more on the electromechanics of this pit formation by dirt. Dirt particles produce the pit by locally insulating the area on which it rests. The normal polarization at this point is disturbed. The polarization voltage is lowered below that required for the deposition of nickel but not necessarily below that which will deposit hydrogen, ferrous iron or copper. The surrounding area will be covered with perfectly good nickel at the partially insulated point. Only hydrogen, iron or copper may deposit.

Sometimes agitation is resorted to for the purpose of shaking off hydrogen bubbles and pitting is thereby eliminated. However, it is eliminated more particularly because the dirt is shaken off.

Now comes the chance which I have been looking for; that is to put in a word about low pH. Due to hydrolysis, nickel, iron and copper sulphates are more soluble at low pH than they are at high pH. Both iron and copper are soluble at pH's below 3 and particularly below 2. It is also true that they will plate out so that a low pH bath will tend to decrease in iron and copper content under normal conditions. A high pH will tend to increase in iron and copper content unless great care is taken to remove them by filtration. This explains why a low pH bath when freshly made or when a high pH bath is converted to lower pH that it both pits and lacks throwing power. After the bath has been worked for some time the throwing power greatly improves and the tendency to pit decreases. I am passing around some samples which will demonstrate this point. All of the small pieces on the wire were plated in a barrel with a pH of 2. A larger piece was plated on a rack at the same pH. We have to admit that iron is not a good thing in a nickel bath, which is somewhat contrary to one of my earlier papers on this matter.

Now a word about peroxide and other oxidizing agents, which are often our friends when pitting is prevalent. How does this stuff do its work? A fairly simple explanation is that in most electrochemical reactions it is easier to reduce a salt from its higher valence to a lower valence than to the metal. It is likewise easier to reduce hydrogen peroxide H_2O_2 to water H_2O than it is to reduce nickel sulphate to nickel. It is reasonably well known that additions of hydrogen peroxide reduce the efficiency of a nickel bath. Put in enough peroxide and you will stop the bath plating. However, in the presence of an oxidizing agent, the voltage required for the deposition of hydrogen is increased and the iron and copper are both oxidized to the ferric and cupric state and do not therefore readily deposit. The polarization voltage in this way is made more uniform over the cathode area and while the plating will be slower it will be more uniform. Hydrogen peroxide or its equivalent therefore provides the temporary remedy but it is often like an aspirin tablet for a headache. After its effect wears off the headache may return unless its true cause has been corrected or it has corrected itself.

Other elements than iron or copper may have an effect on pitting. I certainly do not claim to know all about this matter but I hope that I have contributed something in at least correlating the knowledge which has been collected. I wish in closing to call attention to the fact that the material for this paper has largely been the work of various members of our organization, particularly that of Mr. Guy Cole, who has acted as my assistant for a number of years.

The Asphalt Pavement

They took a little gravel
And they took a little tar,
With various ingredients
Imported from afar.
They hammered it and rolled it,
And when they went away
They said they had a pavement
That would last for many a day.

But they came with picks and smote it
To lay a water main:
And then they called the workmen
To put it back again.
To run a sewer pipe
They took it up some more;
And then they put it back again,
Just where it was before.

They took it up for conduits
To run the telephone;
And then they put it back again,
As hard as any stone.
They took it up for wires
To feed the electric light,
And then they put it back again,
Which was no more than right.

Oh the pavement's full of furrows!
There are patches everywhere.
You'd like to ride upon it,
But it's seldom that you dare;
It's a very handsome pavement:
A credit to the town.
They're always diggin' of it up
Or puttin' of it down.

—*The Washington Star.*

EVALUATING LACQUER FINISHES

By J. A. Reinhardt and E. A. Woelfel

Read at Chicago Annual Meeting, February 27, 1932

Recent years have witnessed a phenomenal growth in the use of sprayed organic coatings on manufactured metal articles. In some instances lacquer has supplanted the electrodeposited finish, but in more cases it has been used to supplement the metal plate, in an infinite variety of hues and degrees of luster.

In many plants the decision to make use of organic finishes has meant more, instead of less, work for the plating and finishing department. As the department responsible for the appearance of the product, it more or less naturally occurs that, at first, spray booths are set up in or adjacent to the plating room. The job of training spraymen is given to the plating foreman, who may, or may not, have had any previous experience with spraying materials. The aim of this paper is to present some practical tests which can be carried out by the foreman plater who finds himself confronted with such a task. All can be performed without expensive special laboratory equipment.

When we first began using colors for clocks, the testing laboratory, which has for years maintained a close chemical control of all production plating baths, was expected to provide the same sort of service in respect to lacquers. This task naturally resolved itself into two major divisions:

(1) Maintenance of uninterrupted production, and (2) testing of the finished product.

Unlike plating bath control, maintenance of lacquer production is not primarily a chemical problem. The factors which determine a smooth flow of parts through the lacquer room are adequate equipment and satisfactory spraying materials. Our laboratory is concerned chiefly with the latter.

When a new shipment of lacquer is received, a number of panels are finished, using the standard procedure as to number of coats, baking conditions, etc. The approximate time of the initial set is recorded, observations are made as to the hiding and covering power, ease of manipulation, etc. When the panels are dry enough to be handled, they are compared with standard color panels. All test pieces are then allowed to dry for a minimum of 48 hours before further testing.

For the purpose of comparing the usability of a number of lacquers, values are assigned to those qualities which are con-

sidered fundamental in a good spraying material. We have, naturally, been governed somewhat by conditions met with in our own industry, but with minor alterations to fit specific cases the schedule of values presented herewith is applicable to almost any opaque or pigmented lacquer.

Film-building and hiding power 40%
Drying qualities 25%
Color and lustre 20%
Manipulation 15%

The above applies about equally to a one-coat finish on metal, whether air dry or baked. Where two or more coats are to be applied, the undercoats should be rated on drying qualities and manipulation, while the finish coat should still be rated as above, except that hiding power can be given a somewhat lower value.

In a one-coat application, the ability of the material to cover and hide small scratches, rough spots, stains and water-evaporation marks is a prime essential. For example, prior to lacquering, drawn brass clock cases are nickelplated to insure clean surfaces and to retard season cracking. In spite of several rinses, ending with hot distilled water, when the cases come from the dryer they always show a water mark on the bottom where the last drop evaporated. To date, about 90% of the various finishes tested have failed to hide these water marks, which fact accounts for the rating of 40% for this property.

Whether the materials under consideration are air-dry or baking, the initial set-up should be as short as possible, in order to prevent the accumulation of dust particles which may imbed themselves in the surface. Generally speaking the time required for the initial set should not exceed five minutes and must be accomplished without "blushing," that is, the precipitation of nitrocellulose by condensation on the film, caused by too rapid evaporation of low-boiling solvents.

Under the head of drying qualities, we must also consider the time which must be allowed before the lacquered parts can be assembled into the finished product. With a baked finish, parts can be handled by the assemblers as soon as they are cool. Many lacquers air dry rapidly enough so that parts may be handled by a careful workman within an hour of spraying, while others may require up to twelve hours drying, before danger of injury to the film is past. By using only lacquers which will dry within

this twelve-hour limit, all the work of one day is ready for the assemblers the following morning.

As a measure of drying time, as well as hardness, the print test is of some value. The test consists of applying a standardized pressure, such as one pound per square inch, to a coated panel, with a piece of cloth between the weight and the lacquer film. The cloth may have a coarse, hard fibre, such as canvas, or may be as soft and thin as cheesecloth. The duration of the test should be short, preferably not over a minute or two. If the lacquer has not dried long enough, the pattern of the weave will be printed in the film at the point of contact.

With respect to color and lustre, each buyer of lacquer must establish some sort of limits to the variation he intends to allow in these qualities. A set of standard panels, showing the ideal, and both extremes in lustre is prepared for each kind of lacquer. These are kept in a cool, dark place to retard change as much as possible, and are brought out for comparison with test panels of newly arrived shipments. Judging of color is more difficult; the best working gauge we have found so far seems to be an experienced eye with a standard color panel. An instrument now on the market, the spectrophotometer, seems to present some possibilities in the problem of determining absolute color values, but as yet none has been available for trial.

As to manipulation, the spray man usually is qualified to furnish information concerning the reduction necessary, any tendency to sag, run or present that undesirable appearance called "orange-peel."

The next series of tests to be described are performed either on the finished articles or on test panels with identical applications of lacquer. Like the others, they have been developed to meet a specific set of conditions, but are capable of considerable variation to fit other and different conditions.

Resistance to perspiration 40%
Flexibility, adhesion and accelerated aging 20%
Moisture resistance in the humidity cabinet ..20%
Hardness—Resistance to abrasion 20%

These tests and their values apply equally to single or multi-coat finishes. While a one-coat finish rarely receives as high a rating as one of two or more, due allowance is made for this difference in evaluating the lacquer on test.

Early in the history of our work it was made evident that alarm clocks had to withstand a considerable amount of handling. Most of this, naturally, is at the hands of the buyer, who winds it once a day, year after year, often with sweaty hands. Except for a more or less standardized oleic acid test, we were unable to find any definite information on the subject. Experimental work with oleic acid and lard oil mixtures, in varying concentrations, failed to give consistent results. A number of requests for synthetic perspiration formulæ were sent out, and when all the returns were in, we had as many different formulæ as there were replies. The effect of each of these was tried, but to date none has proven as reliable as the test that developed as follows.

In the midst of the search for a satisfactory perspiration test, someone suggested that we try natural sweat. Accordingly, one hot day last summer one of the laboratory force was given a clock case and told to massage it until something happened. In about an hour something did happen. The lacquer film, which was in perfect condition at the start, had deteriorated until it could be scraped away from the metal case like so much soft putty. From this has been developed a test, which, considering the uncontrollable variables it embodies, is surprisingly consistent. When tests are to be conducted, four human "sweat-producers," each with two clock cases sprayed with the lacquer to be tested, are stationed on a platform in the power house, up between the tops of two boilers. The temperature is fairly constant at 135° to 140°F. Each man rubs a clock case for five minutes with hands as wet with perspiration as he can keep them (at 140°, you may be sure he has no difficulty), then passes it on to his neighbor, receiving one in turn. At intervals, each one is tested with a finger nail, to see if the finish can be scratched off, and the rubbing is continued until the coating is reduced to the same puttylike consistency which was noted in the original test. If a lacquer survives two hours of this treatment, it is considered to have passed the test with flying colors. The tests are all run in duplicate, and rarely is there more than five minutes' difference in the time required to break down the two samples. Tests run on the same lacquer on different days and with different "sweaters" still fall within that range of error. Although such a procedure violates nearly all the rules of an exact science, it has, nevertheless, proven

to be the only practicable one of many tried, and is being used while the search for a more comfortable substitute goes on.

We have recently been informed that the Bell Telephone laboratories use a variation of this method in testing some of their finishes. Finished panels are set into a specially made leather belt, which is strapped next to the skin on the stomach of the fattest night watchman. The lacquer that survives three weeks of this poisonous contact is adjudged to be satisfactory.

Incidentally, although we have not found the method described to be quite as satisfactory as our own, we are in accord with Shakour and Munchmeyer, whose article on the "Evaluation of Clear Nitrocellulose Metal Lacquers" appeared in "Metals & Alloys" for December, 1931, that "no nitrocellulose lacquer film has yet been found which has outstanding resistance to perspiration, as well as being entirely satisfactory in all other important properties of metal lacquers." The two-hour duration of the sweat test was chosen as the maximum that could be expected if a lacquer were to show satisfactory performance with respect to all other tests.

Like most organic substances, lacquer films are subject to deterioration with age, in which heat, cold, sunlight, air and moisture all play their parts. Brittleness and loss of adhesion are evidences of such deterioration. With the help of a representative of a lacquer manufacturing company, the following methods have been evolved for accelerated aging. A Weather-ometer, such as developed by the Bureau of Standards, would perhaps have served to better purpose, but was not available for our use.

Along with the panels already mentioned, a number of strips of cold rolled steel, 12″ x 2″ x .025″ thick, are also prepared. After 48 hours of drying, they are placed in a constant temperature oven at 145° to 150°F. for 24 hours. From there, with about an hour to cool, they are put in a small electric refrigerator set at 0°F. At the end of 24 hours they are removed and allowed to come to room temperature. A bend is made in one end of the test strip around a piece of ⅜″ rod, and the bent part examined for evidences of cracking or peeling. If the lacquer seems to be in good condition the bend is cut off and the remainder of the strip put through a repetition of the heat-and-cold cycle. This is continued until the lacquer fails. Many of the lacquers fail after completion of the first cycle, while a few have shown no brittleness or lack

of adhesion after 21 cycles. As in the case of the perspiration test, maximum flexibility seems to be obtainable only at the expense of some other desirable qualities, so six cycles have been chosen as a minimum. To some extent this test also serves as a measure of the permeability of the film, since moisture always condenses on the surface when the strips are removed from the refrigerator, causing rusty spots to appear wherever the film is porous.

Note—If a refrigerator such as described is not available, it is frequently possible to beg enough space for a few strips in the cold room of some local ice-cream factory, butcher shop or packing plant.

Closely allied in purpose to the heat-and-cold cycle is the humidity cabinet test. A 100-watt lamp in series with a rheostat was placed in an old ice-chest, and the temperature adjusted to about 110°F. In the bottom of the chest were placed two large beakers of distilled water, fitted with wicks to aid evaporation. On a wire rack above the light and water are placed strips and lacquered parts which must show no signs of cracking or softening after two weeks' time. If rust spots appear through the film it is, of course, evidence of porosity.

If so desired, the above two tests may be combined into one heat-cold-humidity cycle, under which conditions the minimum is four cycles instead of six.

These two tests have practically supplanted the salt spray test, since we found that a great many coatings actually seemed to come out of the salt spray in better condition than they were when put in. This was particularly marked in the case of the lacquer that failed so badly on the perspiration test, for after 100 hours of salt spray, it was still apparently in good condition, and subsequently outlasted the untreated lacquer in the sweat test.

In addition to the print test, some attention must be paid to hardness and wearing qualities. In our plant Mr. Danz, the finishing foreman, has a highly educated thumbnail with which he is able to predict the wearing properties of a finish with considerable accuracy. In fact, a good thumbnail scratch often is used to show up a lacquer deficient in hardness or adhesion and so save the time that would otherwise be consumed with further tests.

On a slightly more exact basis, we have an abrasion test, in which we allow a stream of 70-mesh emery to fall against a test panel. The apparatus consists of a glass tube of about six millimeters bore, three feet in length, with a six-inch diameter funnel at the top. The exact spot to be abraded is carefully gauged with a micrometer caliper, and the panel is then placed at an angle of 45°, fourteen inches below the outlet of the 6 mm. tube. The emery falls until the first spot of metal becomes visible through the lacquer, then the panel is removed, the surplus lacquer washed away from the abraded spot and the thickness of the metal is again carefully gauged, the difference between the two readings being the thickness of the lacquer film. The result is generally expressed in weight of emery or minutes of time required to wear through one thousandth of an inch of film. The abrasion test in varying forms is widely used, but this seems to be the simplest form and is sufficiently accurate for most purposes.

The final rating of a lacquer must be determined by taking both sets of tests into consideration. Forty per cent of this rating depends on the first group of spray-room tests and sixty per cent on the second group of finished product tests. Under this plan, the final standing of the tests is something like this:

Film-building and hiding power	16%
Drying qualities	10
Color and luster	8
Manipulation	6
Resistance to perspiration	24
Flexibility, adhesion and aging	12
Humidity cabinet	12
Hardness—Resistance to abrasion	12

In our work, we have made it a rule that total failure in any one test automatically eliminates that lacquer from further consideration. The minimum grade required to approve a lacquer is largely a matter of common sense and expediency, since it is obvious that the finish on a dollar clock need not be of the same degree of excellence as that on one that costs five dollars. One fact should be noted, however; the lower the price at which an article must be sold, the greater becomes the importance of the first group of tests in proportion to the second. In using this or any other set of tests for lacquer evaluation, the tester must keep

constantly in mind the nature, use and price of the finished article, and rate his tests accordingly.

Finally when two or more lacquers have been found to be satisfactory for the same purpose the deciding factor must of necessity be cost. This is easily determined by spraying a number of similar parts, say 1000, with each of the lacquers under consideration, and carefully measuring the amounts of lacquer and thinner used. The cost of material per piece can then be calculated. If the decision must be made between a baked and an air-dry finish, the cost of operation of the baking oven and the additional labor must be figured in. Where space is at a premium, this additional cost may frequently be offset by the release of the space occupied by drying racks when an air-dry finish is used.

In conclusion the writers wish to make grateful acknowledgment to Mr. E. H. Bucy for his help and advice in establishing and organizing these tests, and to Mr. M. C. Danz and Mr. F. W. Smith, of our organization, who have been instrumental in carrying them to successful completion.

ST. LOUIS BRANCH

will hold its

Annual Get-Together Party

on SATURDAY, *April* 9th, at 1.15 *p.m. at*

THE AMERICAN ANNEX HOTEL, 6th and Market Sts.

Lunch will be served at that time. Educational session will follow, Mr. H. H. Williams being chairman of same. Dr. L. E. Stout will be the main speaker. His subject will be:

DIAGNOSES AND CORRECTIONS OF FAULTY SOLUTIONS

Another speaker will be Mr. B. G. Daw. His subject will be:

SOME METHODS USED IN CHROMIUM PLATING

These subjects should be of interest to all and anyone wishing to attend get in touch with MR. E. J. MUSICK, 206 So. Ninth St., St. Louis.

Do Not Forget the Time and Place

BRANCH NEWS

CLEVELAND BRANCH

On Saturday evening, March 5, the members of the Cleveland Branch held an open meeting with their wives and friends as guests.

At this meeting we had the pleasure of viewing the "Anaconda" film of the American Brass Company and "True Color Slides" by our President, Mr. Thompson.

Everyone present enjoyed these exhibits and are grateful to the American Brass Company and Mr. Thompson for their entertainment.

PAUL STAMM, *Secretary.*

HARTFORD-CONNECTICUT VALLEY BRANCH

The Hartford-Connecticut Valley Branch A. E. S. held its regular monthly meeting on Monday evening, February 29, 1932, at the Springfield Chamber of Commerce, Springfield, Mass.

The meeting was called to order at 8:30 p.m. with President Fleming in the chair. Minutes of the previous meeting were read and accepted. One bill of twenty-one dollars and fifty-three cents ($21.53) for our 3rd quarter P.C.T. was ordered paid. Two communications were read and placed on file.

It was voted to hold our annual Educational Session and Banquet at the Hotel Bond some time in May, the exact date to be decided later. It was also voted to have paid advertising, and Mr. W. D. MacDermid was elected to take charge of it.

Mr. L. W. Curtis, Chief Engineer of the United American Bosch Corporation of Springfield, Mass., was our speaker for the evening. He gave a very good talk, accompanied by mechanical illustrations, on "Radio Made Simple." His talk was very interesting and much appreciated and on conclusion he was given a rising vote of thanks.

The meeting was attended by fifteen members and was adjourned at 10:30 p.m.

V. E. GRANT, *Secretary.*

BOSTON BRANCH

Boston branch met Thursday, March 3, at the American House with President Gale in the chair.

After the regular order of business the reports of committees were made. The chemistry class is getting along fine.

The open meeting and supper held at the last meeting was a success. Everyone had a good time and the branch intends to run more of them.

One application was received for membership.

A membership drive will be started and a committee has been appointed. The chairman is Mr. B. F. Lee; C. H. Hardy, Donald Wood and A. W. Garrett are the other members.

Mr. Fred Dullea of Boston branch gave a very interesting talk on the "Silvering of Mirrors" and it will interest all the members of the Society. He answered all questions and was given a vote of thanks.

HISTORY OF MIRRORS

By Fred P. Dullea

It may be safe to say that the history of mirrors began when Eve caught a glimpse of her charms in one of the clear pools in the Garden of Eden.

Little can be said of man's first knowledge of reflective surfaces, for our earliest records show mankind using polished metal.

The earliest mirrors of which we have any knowledge were polished metal surfaces. We may be sure that the art of polished metals began in the prehistoric times, for we have records of the Egyptians using them. Knowing polishing and buffing as every plater does, it seems very wonderful to me that primitive people with such crude tools at their command could polish any piece of metal well enough to serve as a mirror.

There are two distinct advantages of a metal mirror over a glass mirror, first, it is not broken so easily. This was taken into consideration by our government when it furnished metal trench mirrors to the soldiers in the last war. You must understand, however, that even the most imperfect trench mirror was far superior to the best of the ancient metal mirrors, so far advanced have we become in the art of finishing and polishing metals. The second advantage is that a metal mirror will reflect a truer image, since the distortion caused by the refraction of light, by the glass, is absent. The great disadvantage of a metal mirror is that the reflective surface is easily damaged by chemical action or mechanical abrasion. This is not true of glass mirrors, unless, of course, the glass is broken or the backing imperfect.

The best authorities tell us that the first mirrors made of glass, with a metal backing, were made in Venice about the year 1300. This was perfectly natural since Venice at that time led the world in the manufacture of glass and glass articles. As is true of all new inventions the first sample mirrors were very crude, but in the case of any article used to cater to the vanity of the female rapid strides are made in their development.

The industry was first introduced into England in the year 1673. All mirrors at that time were made by backing glass with an amalgam of tin. These are our old familiar quicksilver mirrors which no doubt many of you have seen. There may have been as many variations in the process of producing these mirrors as there were manufactures, but the general process was as follows:

After the glass had been highly polished on both sides, it was laid on a perfectly level table of great strength and solidity, usually of smooth stone, made like a billiard table, with raised edges. A sheet or sheets of tinfoil sufficient to cover the upper surface of the glass were then laid on and rubbed down smooth, after which the whole surface was covered with quicksilver, when it immediately formed an amalgam with the tin. The superfluous mercury was then run off and a woolen cloth spread over the whole surface. Square iron weights were then applied until a pressure of two or three pounds to the square inch was obtained. After this pressure had continued for a day and night, the weights and the cloth were removed and the glass changed to another table of wood with a movable top, which permitted the glass being slightly inclined at first, the inclination was gradually increased until all the unamalgamated quicksilver had drained off, and only the amalgamated perfectly adherent film remained coating the glass. From eighteen days to a month were required to complete this process.

In 1835 Baron Liebig, the great German chemist, observed that on heating an aldehyde with an ammoniacal solution of silver nitrate in a glass vessel, a brilliant deposit of metallic silver was formed on the side of the vessel. To this observation the modern process of silvering mirrors owes its beginning.

All methods of silvering glass at present are based on the reduction of metallic silver from its ammoniacal salts by a suitable reducer. Various reducers are used, for instance, formaldehyde, Rochelle salts, glucose, etc.

There are various methods of silvering glass, but I shall attempt to describe the method with which I am most familiar. This method is known as the Brashear Process.

After the glass has been satisfactorily polished on both sides it is immersed in hot caustic for two or three minutes, it is then rinsed in water and dipped in strong nitric acid and then back to the rinse water. It is then taken to a table where the surface to be silvered is rubbed all over with the finest whiting, using a soft felt pad and water. After the whiting has been thoroughly washed off with running water the glass is then ready to be silvered. The silver solution, freshly mixed with its reducing solution, is poured on while the glass is still wet. Small portions of the solution are poured on until the required thickness is obtained.

The silvered surface is thoroughly washed with running water, cold and then hot, the mirror is allowed to dry thoroughly and a suitable backing applied.

In the case of ordinary mirrors which do not have to stand elevated temperatures the silver is usually painted with a coat of shellac and then one or two coats of mirror backing paint. This backing serves two purposes, first, it protects the silver from moisture or gases in the air, second, it furnishes mechanical protection. In the case of mirrors or reflectors which are required to withstand elevated temperatures up to 250 deg, or 300 deg. C., the backing previously mentioned is useless in that it breaks down at such high temperatures. Different producers of high temperature mirrors use different backings, each one developing his own.

There are two solutions used in silvering glass and they are mixed just before application to the glass. One contains the silver in the form of silver ammonium-hydroxide in which form it is most easily reduced to the metal. In making this solution chemically pure silver nitrate is dissolved in distilled water and chemically pure ammonium-hydroxide is added until the precipitate formed just disappears. The solution is then made strongly alkaline by adding chemically pure sodium hydroxide. This solution when properly mixed will have just a very faint cloudiness showing that ammonia is not in excess. From this solution the silver is reduced to the metallic form by the addition of a second solution containing a reducing agent. The one with which I am most familiar is a solution of invert sugar. This is a mixture of glucose and fructose which results from the breaking down of sucrose with nitric acid in an alcoholic solution.

At our next meeting Mr. Arthur J. Mintie, one of our new members, will give a talk on "Barrel Plating."

The meeting adjourned at 10:15 p.m.

A. W. GARRETT, *Secretary.*

DAYTON BRANCH

The Dayton Branch held its regular monthly meeting Saturday, February 7, 1932, at the local Y.M.C.A. with our president, Mr. Cusick, presiding.

After the regular business of the branch was disposed of our visitors of the evening were introduced, there being two present, Mr. Potter, chemist with McQuay-Norris Co. of Connersville, Ind., and Mr. Clayton, with Hanson Van Winkle Co., who is a member of the Anderson Branch.

Mr. Potter gave a short talk on the plating of dies and gauges and also gave comparisons as to the service rendered by these parts as against

those not plated. Dayton Branch is always glad to welcome visitors and we hope to have the pleasure of meeting these gentlemen again soon.

The absence of Mr. Fraine and the report of his illness was received with much regret, as he was to have had something of importance for us, but we sincerely hope to have him with us at the next meeting.

The discussions for the evening included Low pH Nickel Chrome, and the possibilities of future finishes, also pickling.

The discussions were interspersed with some "tall stories," as told by several of our members in regard to things seen and heard in various plating shops.

The Chemical Control Class under the direction of Mr. Suman is making very good progress and the attendance and interest are very gratifying.

At a late hour the meeting adjourned until the first Saturday evening in March.

WARD PROTSMAN, *Recording Secretary.*

LOS ANGELES BRANCH

The regular monthly meeting of the Los Angeles Branch was held February 10, 1932, at the Chamber of Commerce Bldg. The meeting was called to order with E. W. Francis presiding and all officers present. The meeting was fairly well attended and was very interesting. There were quite a few very good questions asked and a great deal of information was learned.

All communications were read and bills ordered paid. One new application was received from Mr. Ed. Cushing, 917 Cole Ave., Hollywood, California. Mr. Chas. Wessell passed away suddenly on January 24, and the Chicago Branch was wired. A letter from the L. A. Branch was read, a copy of which was sent to Mrs. Chas. Wessell with check received from the Chicago Branch, of which Mr. Wessell was a member.

Mr. Ben. Foss, Chairman of Banquet Committee, reported on the Third Educational Session and Dinner Dance, which will be held in the Gold Ballroom at the Alexandria Hotel on Saturday, March 12. He said that everything is going along fine but for every member to get back of the project and make it a big success. We had four visitors with us, Mr. DeWitt from Peoria, Ill., Mr. Bellinger from Chicago, Mr. J. Pfister of Los Angeles, and Mr. E. G. Lovering of the Detroit Branch. We were very happy to have had Mr. Lovering present at our meeting, and of course he met some old timers from back East, who have settled in California.

A letter recently received from the United Chromium, Inc., was read at this meeting and it seems to answer a question put in the Box last November, at which time the branches were asked to help answer same through the REVIEW or otherwise. The secretary of this branch received replies from practically every branch of the society. Some apparently were very enthusiastically concerned, while some would not express themselves either way, but no branch wanted to commit itself as an authority on that point.

M. D. RYNKOFS, *Secretary.*

MILWAUKEE BRANCH

The regular meeting of Milwaukee Branch was held at Lipps Hall, 3rd and W. Highland Ave., on March 10, 1932. President M. Nishwitz called the meeting to order, all officers being present. The smoker committee reported it had secured the date of April 30, 1932, for our smoker. Milwaukee Branch was well represented at the Chicago Branch Educational Session and Dinner Dance, February 27, 1932. The members are taking interest in the coming Educational Meeting and Smoker. The committee made a very favorable report, and a fine educational session is anticipated from reports on hand. The Chemical Class has made very good progress, and the boys are disappointed that the class will close in about a month.

FRANK J. MARX, *Secretary-Treasurer.*

WATERBURY BRANCH

The Lea Manufacturing Company's plant was the gathering place for the members of Waterbury Branch on the occasion of their meeting, Friday evening, March 11. The spacious laboratory and office quarters were none too large for the audience, which turned out anticipating an evening of unusual entertainment. The regular routine was dispensed with. No business was transacted, the meeting being turned over to the entertainment committee, Ellsworth Candee, Wm. Cavanaugh and Earl Couch, who had the arrangements in charge. An excellent program of entertainers was furnished, which included three vaudeville acts from the Clements Entertainment Bureau of Hartford, and B. S. Budge of New Haven with his moving pictures. The committee did not stint itself in the refreshment line and a bounteous supply of various kinds was on hand. Large delegations from both the Bridgeport and Hartford Branches were present and enjoyed the festivities of the evening. The next meeting of the Branch will take place Friday evening, April 8, and a big attendance is looked for.

W. F. GUILFOILE, *Secretary.*

DETROIT BRANCH

The March meeting of Detroit Branch was another interesting and well attended gathering. Mr. J. F. McCullough read an interesting paper dealing with experiments in chromeplating and detailing research made by him in that field. It brought forth a lively discussion and Mr. McCullough answered a number of questions by members. Mr. McCullough will put his paper in shape for the REVIEW.

On February 10, quite a number of our members attended the meeting of The Electrochemical Society and enjoyed a very interesting and instructive evening.

Mr. B. F. Lewis presided over the Question Box period, during which the following questions were asked and answered:

Question—What is the best method of stripping chromium deposit from nickelplated die castings?

Answer—Five volts reverse current in boiling alkali cleaner which contains no sulphates.

Question—Is it possible to get good results from a chromium bath with 9 oz. of chromic acid per gallon?

Answer—Not with the "sulphate" bath.

Question—What is the best method of drying work after chromium-plating?

Answer—1. Clean with Bon Ami by hand, or
2. Pass through oxalic acid solution and hot water, or
3. Rinse in hot water and color with lime composition, or
4. Rinse in cold water spray, dry in air or oven, and color with lime.

Question—What is the best type of cleaner to use previous to chrome-plating?

Answer—Any alkali cleaner which will provide a reducing action on the nickel, rather than an oxidizing action, and which rinses freely and neutralizes completely in the acid dip is suitable for use prior to chromeplating, under proper conditions of concentration, temperature and current density used in operating the cleaning unit.

Question—What other composition beside antimonial lead is being used as anodes in chrome baths?

Answer—An alloy of 93% lead and 7% tin is recommended.

Question—What is a good solvent to remove white lead from steel parts?

Answer—Soak in a boiling solution of strong alkali, or use one of the chlorinated solvents.

ST. LOUIS BRANCH

Regular meeting of St. Louis Branch was held on Friday, March 11, 1932, at the plant of Lassalco Co., Inc. In the absence of President Kells, Mr. Musich was appointed. Rollcall of officers showed three absent. Minutes of previous meeting were read and approved and all bills ordered paid.

A card of thanks was read from the Lamkemeyer family for our words of sympathy. Letter also from our old friend, Walter Fraine, thanking St. Louis Branch for our donation to the Research Fund.

On report of committees, Mr. Williams stated that the educational side of our get-together party was all set and Mr. Musich would make all arrangements. It was decided that it would be held on the 9th of April at 1 p.m., and Dr. Stout of Washington University would be the headliner.

Motion was made to suspend Floyd Thompson, 2603 Brooklyn St., Detroit. I was very sorry to hear of the death of Geo. Dulgavian of 1431 S. Los Angeles St., Los Angeles, Cal., a former St. Louis Branch member. Mr. Rushton wrote and let me know of it.

The meeting was then turned over to Dr. Stout, who gave a review on chromium plating, which was enjoyed by all.

There being no further business, meeting adjourned with fifteen members and visitors, at 10:30 p.m., to meet at our get-together party, April 9, 1932, at 1:30 p.m.

CHAS. T. MCGINLEY, *Secretary.*

THE ANNUAL

Educational Session and Smoker

of the Milwaukee Branch, A. E. S.

WILL BE HELD ON

SATURDAY, *April* 30, at their hall

N.W. corner North 3rd St. and Highland Ave.

THE EDUCATIONAL SESSION WILL BEGIN PROMPTLY AT 7.30 P. M.

All platers and their friends who are interested, as well as chemists and manufacturers and others interested in metal plating and finishing, are invited to attend this session as well as the smoker and entertainment which will follow. A good program of papers and talks is being prepared. There will be plenty of refreshments and good cheer, for which Milwaukee is noted.

This smoker is to take the place of the Annual Banquet

The Committee in charge will make this event one to be remembered, therefore

Do Not Miss It!

CHICAGO BRANCH

The regular monthly meeting of Chicago Branch, A. E. S., was held Saturday, March 12, 1932, at the Atlantic Hotel.

The meeting was called to order with President J. C. Kretschmer presiding and all officers present.

Mr. Huenerfauth, chairman of the Banquet Committee, read a report of the 20th annual banquet held in the Gold Room of the Congress Hotel, Saturday, February 27, 1932. The session was well attended, and the papers read were very interesting and educational.

The banquet was a great success in attendance and social pleasure, in fact, we heard many compliments on the arrangement, and the room where the banquet was held.

Members from the following branches attended the banquet—Milwaukee, Anderson and Detroit.

Mr. Gilbertson, chairman of the chemistry class committee, gave a report on the progress the class is making. Mr. Faint read a paper on the hazards in chromium plating. It is necessary for all to know that chromeplating is dangerous business, and that those employed ought to be fully protected against hazards. All members who would like copies of this paper write secretary.

The Convention Committee is requesting papers to be read at the Philadelphia, Pa., convention. It would be a great honor if a member of Chicago Branch was awarded the Gold Medal for the best papers read. Well, members, let's get busy.

Pres. J. C. Kretschmer announced that the annual Educational Session and Smoker of the Milwaukee Branch will be held Saturday, April 30, 1932.

"Hey, hey, Milwaukee," Chicago will be seeing you.

The business part of the meeting having been taken care of, the meeting was turned over to the librarian, Mr. O. E. Servis, and the following questions were found in the Box:

Question—What would cause water breaks on brass after work is electric cleaned, work is buffed and colored?

Answer—Grease on top of cleaning, lack of current or buffing composition not right.

Question—In cleaning cold rolled steel should direct or reverse current be used?

Answer—Direct current should be used. Most trouble in cleaning cold steel is that not sufficient current is used.

Question—What acid is best to use for pickle on work which is to be chromeplated? Dilute sulphuric acid or muriatic acid?

Answer—Would make no difference.

Question—Can steel anode containers be used in cyanide zincplating sol., without detrimental effects?

Answer—Yes.

Question—Is it advisable to use tin in a bronze sol. in connection with zinc to get a golden bronze deposit? If tin is to be used what amount should be used?

Answer—It's best to keep it out, tin will not stay in the sol.

Question—Will a piece of die casting, plated in a nickel sol., containing 20 ozs. of sodium sulphate per gal. break down quicker in a salt spray test, than one plated in nickel sol. that has no sodium sulphate in nickel sol.?

Answer—It depends entirely on the thickness of deposit.

E. G. STENBERG, *Secretary.*

NEW YORK BRANCH

The regular meeting of the New York Branch was held Friday, March 11, 1932, at the World Building. The meeting was called to order by Mr. Ralph Liguori, president. All officers were present except Sergeant-at-Arms F. Muschler and Librarian Harry Fliedbaum.

The banquet of the New York Branch was quite a success considering the prevailing conditions in the industry.

The Branch has called a summons meeting for April 22d to vote whether the Branch should increase its dues from $6.00 to $10.00 per year for the purpose of forming a chemical class and having a laboratory.

There were many discussions both pro and con as to whether nickel-plated work becomes passive when not being chromium-plated within a few days. Anodes for rhodium-plating were discussed. Statement made platinum anodes were not necessary for rhodium-plating. Carbon anodes not containing any graphite are used to good advantage instead of platinum anodes.

JOSEPH MUSANTE, JR., *Recording Secretary.*

A Letter to all our Active Members

Dear Member Plater:

We are anxious to have the Educational sessions of the Philadelphia Convention the best ever. The educational meetings of the convention have been arranged in three divisions as follows:

TECHNICAL—DR. H. S. LUKENS, *Chairman*
Papers from Colleges and Technical Societies

INDUSTRIAL—DR. A. K. GRAHAM, *Chairman*
Papers from Industrial Chemical Plants and Associate Members

ACTIVE MEMBERS—S. T. LUNBECK, *Chairman*
Reports of the Research Committee, Educational Bureau, and Papers from our Active Members

In the past we have had more of the highly technical papers than we have had papers from the practical PLATER himself, so I am appealing to the PRACTICAL man to give us a paper, telling us in his own way just what he does to keep production up to the efficiency demanded today.

The everyday job which you are doing may seem simple to you, but your story may mean a lot towards the standardization of the "Common Practice" used in Electroplating, so let us have your story of how you keep your daily rejects to a minimum.

These papers should be forwarded to me by May 15 to be placed in the official programme of the convention.

Hoping and thanking you for your coöperation, I am,

Yours very truly,

S. T. LUNBECK, *Chairman,*
ACTIVE MEMBERS' PAPERS COMMITTEE,
3304 Washington St.,
Wilmington, Del.

APPLICATIONS

ARTHUR J. MINTIE, 50 Channing Street, Wollaston, Mass.....Boston
EUGENE PHILLIPS, 67 Roanoke Avenue, Fairfield, Conn.....Bridgeport
HARRY E. GILLIS, 1220 Bellevue Avenue, Elgin, Ill.....Chicago

ELECTIONS

ARTHUR J. MINTIE, 50 Channing Street, Wollaston, Mass.....Boston
JOS. W. MEYER, 3536 W. 59th Street, Chicago Ill.....Chicago
SAMUEL DE JACK, 4333 N. Drake Avenue, Chicago, Ill.....Chicago

RESIGNATIONS

B. W. GILCHRIST.....Detroit
C. MCKENZIE.....Detroit

SUSPENSIONS

M. S. KATZIFF, 11 Sea Foam Avenue, Winthrop, Mass.....Boston
J. V. DUFRESNE, 40 School Street, Somerville, Mass.....Boston
F. G. CYREX, Hanson, VanWinkle-Munning Co., Matawan, N. J. Cleveland
A. KRAUSS, 5860 Wickfield, Cleveland, Ohio.....Cleveland
C. A. BRADEN, 1272 Beach Street.....Cleveland
W. WOLINSKI, 1622 Vance Street, Toledo, Ohio.....Toledo
W. C. GROB, % Grob Plating Company, Toledo, Ohio.....Toledo
N. J. KEIFER, 1133 Page Street, Toledo, Ohio.....Toledo
S. LEDZEANOWSKI, 23 W. Strucher Street, Toledo, Ohio.....Toledo
P. J. DRESSELL, % Dura Company, Toledo, Ohio.....Toledo
W. J. FINNEGAN, 8 Rollinson Road, Worcester, Mass.....Worcester
C. T. LINDGREN, East Templeton, Mass.....Worcester
E. W. MALMBERG, Hedstrom Union Company, Gardner, Mass.....Worcester
O. E. LUNDGREN, A. S. & W. Company, Worcester, Mass.....Worcester
T. F. MULLINS, Winslow Skate Company, Worcester, Mass.....Worcester
F. W. PRICE, 6 Summerhill Road, Worcester, Mass.....Worcester
G. H. SOGEGIAN, 15 Hermon Street, Worcester, Mass.....Worcester
F. WOODS, 6 Bradley Street, Worcester, Mass.....Worcester
FLOYD THOMPSON, 2603 Brooklyn Street, Detroit, Mich.....Detroit

DEATHS

WILLIAM CARRICK, 1346 Foulkrod Street, Philadelphia, Pa.....Philadelphia

ELEMENTARY COURSE

in Chemical Analysis of Plating Solutions

IN ORDER to familiarize the membership with the work of the Bureau of Education we are sending each Branch a copy of the "Elementary Course in Chemical Analysis of Plating Solutions." The object of the course is to devise a "Definite Plan" for the conductance of Classes for Platers by Branches that do not have classes. The booklet contains directions for sampling, use and care of apparatus, preparation of standard reagents, analysis of nickel, cyanide copper and chromium solutions.

One hundred copies of the booklet have been mimeographed. Each Branch and district chairman will receive a copy free. The balance, or approximately seventy copies, are to be sold at one dollar each.

Should conditions warrant, additional copies will be mimeographed. All copies over the first hundred will net about 40% profit, which will be donated to the Research Fund. Copies of the booklet can be secured through your branch secretary, or by writing to Albert Hirsch, 1945 W. Airdrie St., Philadelphia, Pa.

Remember, when you purchase this booklet you are helping the Research Fund

RESEARCH COMMITTEE

Chairman, JACOB HAY.....6920 Ottawa Ave., Chicago, Ill.

Sec.-Treas., WALTER FRAINE.....507 Grand Ave., Dayton, Ohio

S. E. HEDDEN.....227 Fifth Ave., Aspinwall, Penn.

WILLIAM F. GUILFOILE.....14 Oakland St., Waterbury, Conn.

DAN WITTIG.....1221 N. Third St., Milwaukee, Wis.

DR. WILLIAM BLUM.....Bureau of Standards, Washington, D. C.

MR. OSCAR SERVIS.....5305 Warner Ave., Chicago, Ill.

MR. N. E. ZADOWSKI.....1383 W. 65th St., Cleveland, Ohio

MR. W. S. BARROWS.....628 Dovercourt Road, Toronto, Canada

C. F. NIXON.....Ternstedt Manufacturing Co., Detroit

DR. H. S. LUKENS.....University of Pennsylvania, Philadelphia, Pa.

BUREAU OF EDUCATION

Chairman, MR. ALBERT HIRSCH.....1945 Airdrie St., Philadelphia

Branch Representatives:

Chicago Branch.....HAROLD FAINT

Waterbury Branch.....ELLSWORTH CANDEE

Los Angeles Branch.....M. D. RYNKOFS

New York Branch.....HENRY LEVINE

Philadelphia Branch.....DR. A. K. GRAHAM

Baltimore-Washington Branch.....DR. WM. BLUM

Cleveland Branch.....J. C. SINGLER

Hartford-Connecticut Valley.....RAY O'CONNOR

Worcester Branch.....M. H. FROMMANN

Toronto Branch.....C. KEMESH

Anderson Branch.....D. A. COTTON

Newark Branch.....PAUL A. OLDAM

Milwaukee Branch .....HENRY BINDER

Other Branch Representatives will be printed as received.